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January 20, 1995

EX PARTE

William F. Caton
Acting Secretary
Federal Communications Commission
Washington, D.C. 20554

Re: PR Docket No. 93-61
Automatic Vehicle Monitoring;
Economic Analysis

Dear Mr. Caton:

In recent months, Metricom, Inc. and others in the Part 15 community have made numerous representations to Chairman Hundt, other Commissioners and Commission Staff regarding the merits of various proposals to amend Part 90 of the Commission's Rules pertaining to Automatic Vehicle Monitoring Systems. These parties have consistently maintained that the public's best interests are not served by rule changes that disadvantage Part 15 uses of the 902-928 MHz band in order to provide opportunities for new wideband LMS services.

In order to bring some important elements of the economic costs and benefits at stake in this proceeding into sharper focus, Metricom commissioned an independent economic analysis of the principal markets involved. Specifically, Metricom retained Darby Associates, a Washington, D.C. consulting group, and Datacomm Research Company located in Wilmette, Illinois, and charged them with developing estimates of the current size, expected growth and likely market penetration of markets for Part 15 products and services. Metricom also requested that they compare those estimates to similar ones for AVM/LMS based on information in the record in this proceeding.

The report summarizing the results of this analysis of alternative uses of the 902-928 MHz band is attached. The study results confirm dramatically the persistent claims that the most economically robust and valuable use of the contested spectrum is one that permits continued and uninterrupted growth of the Part 15 unlicensed services that the Commission has encouraged and fostered over the past decade. Specifically, we call your attention to

Table 3 which illustrates that based on past performance, 900 MHz Part 15 products and services can be reasonably expected to reach $1.8 billion by 2000, compared to something on the order of $40 million for AVM/LMS services.

These and related points in the analysis lead Darby Associates to conclude, based on the limited data about AVM/LMS markets in the record, that historic and expected market developments clearly suggest "that a shift in favor of AVM/LMS systems, and adverse to unlicensed services in the 900 MHz band, will likely destroy more economic value for the public than it creates." Based on their analysis of the data, Darby Associates concludes "the thrust of our analysis and market calculations is that such proposals may very well reduce total economic welfare, as measured by the total value of market sales from the contested spectrum."

Based on the attached analysis, it is clear that a Commission decision in this proceeding that does not fully protect and encourage Part 15 operations in the 902-928 MHz frequency band would be detrimental to the public interest.

In accordance with Section 1.1206(a)(1) of the Commission's Rules, two copies of this letter, along with the attached report, are being filed with the Secretary's office.

Sincerely,

Henry M. Rivera

Henry M. Rivera

cc: Chairman Reed Hundt
Commissioner James Quello
Commissioner Andrew Barrett
Commissioner Susan Ness
Commissioner Rachelle Chong
Regina Keeney, Chief WTB
Robert Pepper, Chief OPP

Economic Impact of Docket 93-61

Preliminary Estimates of Market Size for Alternative Uses of the 902-928 MHz Band

Comments in support of Metricom, Inc.

Larry F. Darby
Darby Associates
Washington, DC

January 13, 1995

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Executive Summary

Value of Alternative Uses of the 902-928 MHz Band

The purpose of this paper is to set forth both a framework and the data available for analyzing the potential economic impact of the Commission's resolution of issues before it in PR Docket 93-61 (In the Matter of Amendment of Part 90 of the Commission's Rules to Adopt Regulations for Automatic Vehicle Monitoring Systems).

This paper summarizes the very limited publicly available information and data on record relevant to estimating the current size and expected growth of two markets: (1) markets for equipment/services operating in the 902-928 MHz band under Part 15 of the Commission's rules; and, (2) markets for wideband vehicle locating and monitoring services (AVM/LMS systems). The results of a more recent and extensive effort to estimate more carefully the size and growth prospects for Part 15 uses of the 902-928 MHz band are presented.

The analysis compares three dimensions of the two markets: (i) their current size, (ii) expected growth rates, and (iii) anticipated sales in the year 2000.

The conclusion is that market forces have been working for several years and have made clear choices in favor of Part 15 operations, and that there are and will be very substantial

differences in the scope and size of these Part 15 and AVM/LMS markets, now and in the year 2000. Depending on which estimates (Department of Commerce or Darby Associates) are used, the 900 MHz/Part 15 market appears to be generating sales fifty to eighty times those generated by AVM systems; and, it appears that this relative differential will continue into the future, absent circumstances not anticipated by analyses in the record of this proceeding. By the year 2000, under the Commission's current rules, estimates in this paper indicate a market for 900 MHz/Part 15 equipment/services in the $1.8 billion range. If they grow substantially faster than in the past, AVM markets might reach $40 million in that year.

This paper makes no claims for the completeness of data underlying the analysis and quantitative estimates. It relies principally on the economic data available to the Commission, but does supplement the existing record as it relates to Part 15, 902-928 MHz services. There is a greater measure of confidence in estimates for Part 15 services in the 900 band than there is for AVM/LMS systems, which have been estimated directly and exclusively from the record of the Docket 93-61 Proceeding.

Analysis of the data in the record, as supplemented below, does not support a conclusion that redefining property rights in ways designed to shift spectrum use opportunities in favor of AVM/LMS systems, at the expense of unlicensed uses, will create

additional economic value for the public. To the contrary, comparison of the available data describing the market acceptance of AVM services and estimates of the market valuation of unlicensed services in the band clearly indicate that such proposals may very well reduce the total economic welfare (measured by the total value of market sales) of the contested spectrum.

Introduction

By its Notice of Proposed Rulemaking in PR Docket 93-61, the Commission has solicited and received comments and evidence respecting proposed rule changes aimed at expanding the current Automatic Vehicle Monitoring Service (AVM) to establish a new Location and Monitoring Service (LMS) in the 902-928 MHz band. Within the 902-928 MHz band, a wide variety of services provided by Part 15 devices are currently operating. As a result of well-considered and long-standing public policy, and with strong endorsements and recurring encouragement from the Commission over the past decade, substantial risk capital has been committed to support operation of a diverse array of Part 15 devices in the 902-928 MHz band.

The record of this proceeding makes clear that creating new spectrum opportunities for use by wideband LMS systems, as proposed by AirTouch Teletrac, MobileVision, PinPoint and others, will occasion new technical interference for, and impose economic harm on, the providers of current and future Part 15 services. Thus, the Commission is faced with the familiar task of optimizing use of the contested 902-928 MHz spectrum by comparing, at the margin, the costs and benefits of alternative property rights in the 902-928 MHz band. While economic considerations generally, and efficient spectrum use more specifically, do not exhaust

its decision-making criteria under the broad public interest standard, the Commission has in recent years been increasingly attentive to the economic efficiency aspects of its spectrum use policies. Indeed, the principal basis for spectrum auctions is firmly grounded in economic efficiency arguments that translate loosely into the case for allocating spectrum to uses that will create the largest economic value.

What follows is a report of the results of efforts to quantify the economic value of the markets at issue, both at present and as they might accumulate in the next few years. Using available data, "best estimates" of current and expected scale and scope of the markets most likely to be effected are reported. The analysis supports a conclusion that markets have weighed the options and that user choices have clearly signaled user preferences. An assessment of the AVM/LMS services market begins the analysis which then turns to markets for Part 15 services and to a comparison of the two markets.

Potential Market Impacts -- The Market for AVM\LMS Services

There is little record evidence indicating the possible magnitude of the economic benefits of the LMS proponents' proposals. The petition for rulemaking filed on behalf of North American Teletrac and Location Technologies, Inc. (Teletrac) (and subsequent representations on their behalf) suggest that the AVM

markets developed to date are modest and that future growth prospects are quite uncertain, even with favorable Commission disposition of Teletrac's petition.[1]

The Teletrac Petition cites four "significant uses" of the Teletrac system:[2] (a) corporate fleet tracking; (b) stolen vehicle and emergency road service; (c) law enforcement; and, (d) personal locator services. A careful review has been made of the descriptions of those services and representations made about their likely economic and social value. The discussion of the size and importance of these four sectors in the Petition is brief and impressionistic. The analysis of the Petition respecting the value of these markets is generally broad and diffuse, almost exclusively qualitative, and, not readily amenable to quantitative treatment. Accordingly, the information made available in the Petition cannot be converted into estimates of current or future market values of AVM/LMS systems by any recognized basis or reasonable methodology.

There is, however, some indirect, albeit limited, evidence on the size of AVM/LMS markets implied by the behavior of current license holders. According to the Commission's Master Frequency File in 1994, while Teletrac and METS/Mobilevision held over

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[1] Petition for Rulemaking, In the Matter of Amendment of Section 90.239 of the Commission's Rules to Adopt Permanent Regulations for Automatic Vehicle Monitoring Systems, filed by North American Teletrac and Location Technologies, Inc; May 25, 1992. (Teletrac Petition)

[2] Teletrac Petition, ¶¶ 10-20.

5,500 licenses covering most metropolitan areas in the United States, only Teletrac has constructed any commercial systems and only six such systems are operating, serving a customer base of approximately 6,000 subscribers.[3]

Teletrac has reportedly incurred over $170 million in costs to provide vehicle location services which, in its words, "...have not yet achieved a significant degree of commercial acceptance."[4] As indicated below, revenues generated by these services have been substantially below these costs, so that the AVM service has consistently generated operating losses. The amount of revenue generated by the AVM/LMS type of service, now and in the future, can only be crudely estimated from information available in the record. We note again that proponents of LMS systems are the best source of such information, but they have not, for good reason, put such information into the record of this proceeding.

For purposes of comparison with the market for Part 15 services in the 902-928 MHz band, this analysis assumes that AVM/LMS markets are now generating revenue at the rate of $10

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[3] While other subscriber numbers may have been discussed informally, this 6,000 subscriber number is the only Teletrac number that could be found in the record.

[4] PacTel Corporation, Prospectus (Dec. 2, 1993) at pp. 24, 57. "Teletrac reported net losses before taxes of $49.1 million, $36.8 million, $12.7 million and 33.3 million during 1992, 1991, 1990, and the nine months ended September 30, 1992, respectively. The Company does not expect Teletrac's operations to be profitable for several years. The Company intends to take actions to reduce Teletrac's operating losses and does not plan to expand Teletrac's operations significantly until its services achieve a higher level of commercial acceptance." Id. at 57.

million per year and growing at over 25% compounded annually. Therefore, by the year 2000, revenues will reach $40 million.[5]

Potential Market Impacts -- The Market for the 900 MHz/Part 15 Services

It is no simple undertaking to estimate the economic value created by manufacturers of equipment and providers of services making use of unlicensed spectrum in the 900 MHz band. Aggregate statistics are not routinely collected, in large part because the Part 15 community is not an industry in the usual sense of the term -- that is, a group of firms producing roughly substitutable equipment and services. Rather, the common bond of Part 15 suppliers, as their name suggests, is reliance on unlicensed use of spectrum; spectrum made available to all comers provided only that they observe certain technical specifications and operational rules provided by Part 15 of the Commission's rules. Since

[5] These revenue assumptions are quite generous in view of what is known about historic growth, the present state and likely development of the LMS market segment. AirTouch Teletrac is the largest provider. The best estimate of their subscriber base places the number in the 6,000 vicinity. Revenue per subscriber is estimated at about $30 per month. Those numbers suggest revenues of less than three million dollars per year. (If there were 10,000 users paying $50 per month, revenues would be $6 million per year). Ten million dollars of current revenue is assumed to assure no underestimates, and the market is assumed to grow in excess of 25% per year. This assumed growth rate is also quite generous in view of LMS' market history, the limitations of the technology and the alternative technologies available for providing highly competitive services. For example, LMS must compete with several communications alternatives that, operating in conjunction with Global Positioning Systems (GPS), can provide vehicle tracking services. These communications alternatives include circuit switched or CDPD cellular telephone, Ardis, RAM Mobile Data, Private Land Mobile Radio Services, Analog SMR, Nextel, Geotech, 220 MHz mobile radio, OmniTRACS mobile satellite service -- eg. AMSC and Orbcomm -- and two way paging from sources like Destineer. Furthermore, for most two way mobile data applications, these other technologies are likely to be preferred by many, if not most, users and, in any event, the LMS technology will find itself in vigorous competition. In summary, the realities of the markets in which LMS has operated and will face in the future, are such that this paper's revenue estimates do and will cover the actual revenue operating performance of LMS systems.

devices and services using this part of the spectrum are not licensed, even the FCC does not have statistics on the sector beyond records of equipment certifications.

There is anecdotal evidence from a variety of sources suggesting the economic importance of the sector. The Information Infrastructure Task Force Committee on Applications And Technology recently listed goals for the National Information Infrastructure (the "Task Force Committee"). There is a remarkable correspondence between the goals listed by the Task Force Committee and the services provided by wireless, unlicensed vendors operating under Part 15. These goals with their associated wireless applications include:[6]

> Managing energy resources and reducing energy consumption (wireless meter reading and intelligent power networks);
>
> Economizing on time and energy through telecommuting (wireless wide area networks and metropolitan area networks -- WANs and MANs);
>
> Provision of safety and relief during emergencies and natural disasters (MANs and WANs have very high survivability and can provide emergency communications; wireless utility metering networks provide for energy load management and rationing);
>
> Increasing efficiency of transport systems (wireless applications can reduce road congestion, increase traffic flow -- rail and highway, people and freight -- thereby increasing productivity); and,

[6] See NIST Report, September 1994

> Supporting nonprofit cultural institutions, protecting the environment, providing assistance for the disabled, and connecting citizens to the means for helping assure public safety (wireless applications operating under Part 15 are now supporting each of these broad public interest goals.)

It is significant and worthy of note here, in view of the announced goals of the National Information Infrastructure initiative, that Part 15 wireless applications might very well prove to be an extremely cost-effective way to provide interconnectivity to schools. While current estimates of the cost of providing wireline interconnections are preliminary and tentative, they appear, as a practical matter, to be almost prohibitive in light of the capacity of current public funding mechanisms.[7] Available quantitative estimates of the level of economic activity generated by the Part 15 sector are spotty and not well-documented. Nevertheless, the data that are available indicate that the sector generates substantial economic activity, as measured by income and jobs, and is enjoying rapid growth at rates well above the average for the economy and for the telecommunications sector more specifically.

In its report to Congress on opportunities to reallocate spectrum, the Department of Commerce estimated that the annual

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[7] Department of Education estimates provided to the NII Task Force Committee on Education suggest that the cost per student of making available a dedicated wireline connection to a LAN with a local server would require a mean investment per student of about $500 and mean annual operating costs per student of about $75. For a summary of these estimates see: Larry F. Darby, "Communications Policy Coming to Reflect Concerns for Investment in Human Capital", Communications Business and Finance, Vol. 1, no.16, September 30, 1994.

sales of unlicensed devices in the 902-928 MHz band were in the neighborhood of $900 million in 1992. The Department projected that sales would grow to over $1.5 billion by 1996, thereby suggesting an expected compounded annual growth rate (CAGR) of about 13% per year. While not giving a full breakdown, the Department estimated the revenues of some specific sectors. These are reported below in Table 1.

TABLE 1

Sales of Selected Non-licensed Devices Operating in the 902-928 Band -- 1992

Consumer Use	Total Units Sold	Annual Sales ($M)
Spread Spectrum Systems	106,500	$500
Wireless Stereo/Video	300,000	45
Cordless Telephones	1,500,000	150
Wireless Barcode Readers	4,000	50
Meter Reading Systems	4,000	30
Wireless Security Alarms Residential systems Commercial systems	 144,000 82,500	 28.8 16.5
TOTAL	2,141,000	$820.3

Source: Department of Commerce, Preliminary Spectrum Allocation Report, p. 3-12.

To supplement these data, further, more careful analyses of Part 15 markets have been conducted. The results are compiled at Table 2, which reports more current estimates, a finer breakdown of Part 15 devices and estimated growth of individual sectors up to the year 2000.

TABLE 2

Part 15 (902-928 MHz) Equipment and Services Markets: 1994 to 2000

($MILLIONS)

	1994	2000
Wireless office LANs	$21.0	$9.0
Wireless PBXs	9.0	26.0
Cordless Telephones	105.0	790.0
Wireless Alarm Systems	6.0	60.0
Wireless Bar Code Scanners RF/DC	62.0	148.0
Wireless Meter Readers & Systems	93.0	168.0
Anti-theft Tags & Other RF/ID Systems	185.0	70.0
Consumer Stereo and Video	4.5	13.0
Wireless Medical Monitoring Equipment	23.0	60.0
Campus Area Networks	20.0	400.0
Telco Bypass	20.0	78.0
TOTAL MARKET VALUE	$548.5	$1,822.0

Source: Datacomm Research Company (Wilmette, IL) and Darby Associates

These estimates map, in many respects, those presented by the Commerce Department and the differences confirm that this paper's analysis has indeed been conservative in its estimating

procedures. Table 2 indicates that the market for Part 15 devices generated well over a half billion dollars in 1994 and that the market in the aggregate may reasonably be expected to grow to almost $2 billion by the turn of the century. This represents an average compound annual growth for the sector of about 22% per year.

While the numbers speak for themselves, attention is directed to the especially rapid growth anticipated for campus area networks, wireless alarm systems and cordless telephones. In addition, the market for wireless PBX systems is poised to take-off in support of efforts to reduce the number of uncompleted long distance voice calls. The most notable reduction in expected sales is in the market for anti-theft tags whose likely decline is attributable to migration to another frequency band or to a non-radio based technology.

The expected growth of wireless meter reading equipment is substantial and will generate nearly a twofold increase in sales by the year 2000. Nevertheless, the value of equipment sales standing alone understates the true value to the economy of these devices.

The utility industry has spent over $1 billion in the past decade developing wireless automated reading systems, and over six million of such devices have been installed or shipped, according to Datacomm Research Company. The payoff to date of

investing in and operating such systems has been substantial, when measured by energy conservation data. One utility alone, Southern California Edison, has estimated a savings of 1 billion kW per year, yielding savings of $40 million per year to its ratepayers as a result of installation of a Part 15 enabled voltage conservation system.

Consumer devices are an important component of this market, accounting for over $90 million in sales in 1994. These sales were apportioned as follows:

- 350,000 cordless phones
- 12,000 medical monitoring devices
- 10,000 wireless speakers, video and home automation devices
- 8,000 residential alarm systems

More than 100 companies have been identified which sell devices operating in the 902-928 MHz band under Part 15 of the Commission's rules.[8] This list is not exhaustive. Most of these are small, entrepreneurial type undertakings of the kind that is responsible for most of the new, "good" jobs that have been created in recent years. There are currently about 6,500 jobs being provided directly by companies producing 900 MHz/Part

[8] Chairman Hundt has stated that: " In the 902-928 MHz band ... the Commission has authorized more than 20 different types of products for operation in this spectrum to more than 130 manufacturers. The Commission receives about 20 applications a month for approval of products in this part of the spectrum." Letter from Reed E. Hundt, Chairman, FCC to the Honorable Larry Pressler, United States Senate (Nov. 23, 1994) p.2.

15 equipment.[9] Indirect employment in upstream, downstream and collateral sectors induced by 900 MHz/Part 15 equipment manufacturing is very difficult to estimate precisely or with great confidence. Nevertheless, it is estimated that employment in related sectors induced by activity in the 900 MHz/Part 15 manufacturing sector is in excess of 20,000 jobs.[10]

Markets Have Worked and the Economic Signals Are Clear

Markets for different services provided in this band have been in play for several years and the verdict is clear. A summary comparison of the data on current market size and scope and anticipated growth for Part 15 services and AVM/LMS service is presented in Table 3 below.

[9] Since most of the more than 100 companies serving this sector are small and/or privately held, available employment information is sketchy. Employment was estimated and prorated for the largest vendors -- for example, AT&T, Global Communications, Uniden, Telxon, Symbol Technologies, Sensormatic, - by referring to annual reports to shareholders. A sample of anecdotal employment information available for a group of smaller companies suggested average employment of about 25 employees per company. Admittedly crude, the best estimate of employment in this sector is in the range of 5,200 to 7,800 with a mean estimate of 6,500.

[10] Given the diffuse nature of the Part 15 supplier community, data based on standard industrial classifications are not relevant. In general, one can derive estimates of the relations among economic activities in different sectors by referring to U.S. input-output tables. However, given the size and diversity of the Part 15 sector, that is simply not possible. Instead, this analysis has relied on knowledge of general economic relations between Part 15 manufacturers and closely related economic activities and firms, e.g., component manufacturers, contract assembly houses, Part 15 certification labs, software developers, OEM vendors, equipment distributors, value-added resellers, systems integrators, installers, field service personnel, and the general impacts in other broad industry segments like transportation and energy. Again, these estimates could be improved by more systematic and detailed sampling and survey techniques.

TABLE 3

Comparison of 900 MHz/Part 15 and AVM/LMS Market Development

	Current Size	Growth Rate	Year 2000
900 MHz/Part 15 Services			
Commerce Department	$820 million	13%	$1.5 billion
Darby Associates	$548 million	22%	$1.8 billion
AVM/LMS Systems	$10 million	25%	$40 million

Source: Table 1 and Table 2 and discussion above

The data in Table 3 clearly indicate a presumption, based on past market tests and reasonably expected future market developments, that 900 MHz services under Part 15 unlicensed rules have outperformed vehicle locating technologies and systems -- and are likely to do so in the future. We note again the paucity of AVM/LMS market information available in the record both for this analysis and the Commission's consideration.

There is nothing in the record, however, to inform a better estimate of the AVM/LMS market. Nor is there any evidence that shifting opportunities to use the 902-928 MHz band toward AVM/LMS services at the expense of unlicensed 902-928 MHz services will,

on balance, create more economic value in this band for the public. Indeed, the data in Table 3 clearly suggest that such a shift in favor of AVM/LMS, and adverse to unlicensed services in the 900 MHz band, will likely destroy more economic value for the public than it creates.[11]

The ultimate impact on the total value of the band depends on the specific rule changes adopted and on the property rights thereby specified for each class of user. It appears that, at the margin, the changes being considered by the Commission are likely to reduce value created by unlicensed users by more than

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[11] It should be noted here that the Commission has conceded in other contexts that the 902-928 MHz band is currently used efficiently; and, it has also recognized the importance of not stranding existing investment in this band by spectrum reallocations. In comments to Secretary Brown regarding the Preliminary Spectrum Allocation Report of the Department of Commerce, the Commission recently agreed to Commerce's characterization that the unlicensed bands are currently used efficiently, and that the large number of existing non-Federal incumbents should eliminate the 2.4 GHz band from consideration for reallocation. While the 902-928 band was not directly at issue, the Commission's comments nevertheless signalled reliance on the pattern of utilization of the 902-928 MHz band as the basis for expressing its views about the merits of reallocating the 2400-2483.5 MHz band. Specifically the Commission observed:

> In 1990 we encouraged development of advanced spread spectrum devices...Today there are literally millions of Part 15 devices operating the 902-928 MHz band, including cordless phones, wireless alarm systems computer local area networks, automated meter reading systems, anti-shoplifting systems, inventory control systems, and automatic vehicle identification systems....Although the 2400-2483.5 mHz band is not as heavily used as the 902-928 MHz band, there has recently been substantial development of, and investment in, equipment using this band...It is unlikely that a licensed service would be able to share this band with these (unlicensed) devices , which operate with up to one watt of transmitter output power under Part 15 of our rules. Accordingly, reallocation of this band would jeopardize the significant private sector investment already made in developing new technologies operating under Part 15.

Based on this analysis, the Commission concluded (at para. 51) that "future changes to this [2.4 MHz] band could jeopardize significant private sector investments already made in this band and could result in a loss of benefits to the public and to the Federal government." See, In the Matter of: Report to Ronald H. Brown, Secretary, Department of Commerce; Regarding the Preliminary Spectrum Reallocation Report. Adopted and released by the Commission: August 9, 1994.

the value likely to be created by an expanded AVM service. While the Commission may be able to fashion rules that will avoid this result, the present analysis should, at a minimum, raise a flag of caution that signals the risk to the public's long-term economic interests of respecifying rights and reallocating opportunities to use this band.

Conclusion

The foregoing indicates that there are substantial economic stakes involved in proposals to redefine and reallocate spectrum use rights growing out of the Commission's PR Docket 93-61. Based on the record, there is no market-based rationale for the various proposals to grant more spectrum use opportunities to AVM/LMS systems at the expense of Part 15 users in the 900 MHz band.

Both AVM and Part 15 uses of the band have been amply tested in the marketplace over the past decade. Drawing on information in the record and from supplementary data compiled for this brief report, it is clear that the "market" to date has expressed a strong preference for the varied unlicensed uses of this band over licensed AVM services. There is also no evidence, beyond the assertions of proponents, to indicate that expanding rights to use this band for AVM/LMS type services will occasion a dramatic departure from the lethargic, historic market demand for

such services.

Finally, there is no evidence in the record to indicate that proposals to shift spectrum rights in favor of AVM/LMS systems, at the expense of unlicensed uses, will on balance create additional economic value for the public. To the contrary, the thrust of this analysis and market calculations is that such proposals may very well reduce total economic welfare, as measured by the total value of market sales from the contested spectrum.